Chapter 1

Introduction

SOLUTIONS TO QUESTIONS AND PROBLEMS

Problem 1.1.

When a trader enters into a long forward contract, she is agreeing to buy the underlying asset for a certain price at a certain time in the future. When a trader enters into a short forward contract, she is agreeing to sell the underlying asset for a certain price at a certain time in the future.

Problem 1.2.

A trader is hedging when she has an exposure to the price of an asset and takes a position in a derivative to offset the exposure. In a speculation the trader has no exposure to offset. She is betting on the future movements in the price of the asset. Arbitrage involves taking a position in two or more different markets to lock in a profit.

Problem 1.3.

In the first case the trader is obligated to buy the asset for $50. (The trader does not have a choice.) In the second case the trader has an option to buy the asset for $50. (The trader does not have to exercise the option.)

Problem 1.4.

Selling a call option involves giving someone else the right to buy an asset from you. It gives you a payoff of

\[-\max(S_T - K, 0) = \min(K - S_T, 0)\]

Buying a put option involves buying an option from someone else. It gives a payoff of

\[\max(K - S_T, 0)\]

In both cases the potential payoff is \(K - S_T\). When you write a call option, the payoff is negative or zero. (This is because the counterparty chooses whether to exercise.) When you buy a put option, the payoff is zero or positive. (This is because you choose whether to exercise.)
Problem 1.5.

(a) The investor is obligated to sell pounds for 1.5000 when they are worth 1.4900. The gain is \((1.5000 - 1.4900) \times 100,000 = \$1,000\).

(b) The investor is obligated to sell pounds for 1.5000 when they are worth 1.5200. The loss is \((1.5200 - 1.5000) \times 100,000 = \$2,000\).

Problem 1.6.

(a) The trader sells for 50 cents per pound something that is worth 48.20 cents per pound. Gain = \((0.5000 - 0.4820) \times 50,000 = \$900\).

(b) The trader sells for 50 cents per pound something that is worth 51.30 cents per pound. Loss = \((0.5130 - 0.5000) \times 50,000 = \$650\).

Problem 1.7.

You have sold a put option. You have agreed to buy 100 shares for \$40 per share if the party on the other side of the contract chooses to exercise the right to sell for this price. The option will be exercised only when the price of stock is below \$40. Suppose, for example, that the option is exercised when the price is \$30. You have to buy at \$40 shares that are worth \$30; you lose \$10 per share, or \$1,000 in total. If the option is exercised when the price is \$20, you lose \$20 per share, or \$2,000 in total. The worst that can happen is that the price of the stock declines to almost zero during the three-month period. This highly unlikely event would cost you \$4,000. In return for the possible future losses, you receive the price of the option from the purchaser.

Problem 1.8.

The over-the-counter market is a telephone- and computer-linked network of financial institutions, fund managers, and corporate treasurers where two participants can enter into any mutually acceptable contract. An exchange-traded market is a market organized by an exchange where traders either meet physically or communicate electronically and the contracts that can be traded have been defined by the exchange. When a market maker quotes a bid and an offer, the bid is the price at which the market maker is prepared to buy and the offer is the price at which the market maker is prepared to sell.

Problem 1.9.

One strategy would be to buy 200 shares. Another would be to buy 2,000 options. If the share price does well the second strategy will give rise to greater gains. For example, if the share price goes up to \$40 you gain \([2,000 \times (\$40 - \$30)] - \$5,800 = \$14,200\) from the second strategy and only \(200 \times (\$40 - \$29) = \$2,200\) from the first strategy. However, if the share price does badly, the second strategy gives greater losses. For example, if the share price goes down to \$25, the first strategy leads to a loss of \(200 \times (\$29 - \$25) = \$800\), whereas the second
strategy leads to a loss of the whole $5,800 investment. This example shows that options contain built in leverage.

Problem 1.10.
You could buy 5,000 put options (or 50 contracts) with a strike price of $25 and an expiration date in 4 months. This provides a type of insurance. If at the end of 4 months the stock price proves to be less than $25 you can exercise the options and sell the shares for $25 each. The cost of this strategy is the price you pay for the put options.

Problem 1.11.
A stock option provides no funds for the company. It is a security sold by one trader to another. The company is not involved. By contrast, a stock when it is first issued is a claim sold by the company to investors and does provide funds for the company.

Problem 1.12.
If a trader has an exposure to the price of an asset, she can hedge with a forward contract. If the exposure is such that the trader will gain when the price decreases and lose when the price increases, a long forward position will hedge the risk. If the exposure is such that the trader will lose when the price decreases and gain when the price increases, a short forward position will hedge the risk. Thus either a long or a short forward position can be entered into for hedging purposes. If the trader has no other exposure to the price of the underlying asset, entering into a forward contract is speculation.

Problem 1.13.
Ignoring the time value of money, the holder of the option will make a profit if the stock price in March is greater than $52.50. This is because the payoff to the holder of the option is, in these circumstances, greater than the $2.50 paid for the option. The option will be exercised if the stock price at maturity is greater than $50.00. Note that if the stock price is between $50.00 and $52.50 the option is exercised, but the holder of the option takes a loss overall. The profit from a long position is as shown in Figure S1.1.

Problem 1.14.
Ignoring the time value of money, the seller of the option will make a profit if the stock price in June is greater than $56.00. This is because the cost to the seller of the option is in these circumstances less than the price received for the option. The option will be exercised if the stock price at maturity is less than $60.00. Note that if the stock price is between $56.00 and $60.00 the seller of the option makes a profit even though the option is exercised. The profit from the short position is as shown in Figure S1.2.
Problem 1.15.

The trader receives an inflow of $2 in May. Since the option is exercised, the trader also has an outflow of $5 in September. The $2 is the cash received from the sale of the option. The $5 is the result of buying the stock for $25 in September and selling it to the purchaser of the option for $20.

Problem 1.16.

The trader makes a gain if the price of the stock is above $26 in December. (This ignores the time value of money.)

Problem 1.17.

A long position in a four-month put option can provide insurance against the exchange rate falling below the strike price. It ensures that the foreign currency can be sold for at least the strike price.
1.26 In this case, the arbitrageur should borrow $600 at 10% per annum for 1 year, and at the same time buy the gold with the money borrowed. Then the arbitrageur should short a forward contract to deliver the gold for $800 in 1 year. The total the arbitrageur would earn in the end is $140.

\[ 800 - 600 \times (1.1) = 140 \]

where \( K = 800 \) and \( S_T = 600 \times (1.1) \).
Chapter 3

Hedging Strategies Using Futures

SOLUTIONS TO QUESTIONS AND PROBLEMS

Problem 3.1.

A short hedge is appropriate when a company owns an asset and expects to sell that asset in the future. It can also be used when the company does not currently own the asset but expects to do so at some time in the future. A long hedge is appropriate when a company knows it will have to purchase an asset in the future. It can also be used to offset the risk from an existing short position.

Problem 3.2.

Basis risk arises from the hedger's uncertainty as to the difference between the spot price and futures price at the expiration of the hedge.

Problem 3.3.

A perfect hedge is one that completely eliminates the hedger's risk. A perfect hedge does not always lead to a better outcome than an imperfect hedge. It just leads to a more certain outcome. Consider a company that hedges its exposure to the price of an asset. Suppose the asset's price movements prove to be favorable to the company. A perfect hedge totally neutralizes the company's gain from these favorable price movements. An imperfect hedge, which only partially neutralizes the gains, might well give a better outcome.

Problem 3.4.

A minimum variance hedge leads to no hedging when the coefficient of correlation between the futures price changes and changes in the price of the asset being hedged is zero.

Problem 3.5.

(a) If the company's competitors are not hedging, the treasurer might feel that the company will experience less risk if it does not hedge. (See Table 3.1.)

(b) The shareholders might not want the company to hedge.

(c) If there is a loss on the hedge and a gain from the company's exposure to the underlying asset, the treasurer might feel that he or she will have difficulty justifying the hedging to other executives within the organization.
Problem 3.6.

The optimal hedge ratio is

\[ 0.8 \times \frac{0.65}{0.81} = 0.642 \]

This means that the size of the futures position should be 64.2% of the size of the company's exposure in a three-month hedge.

Problem 3.7.

The formula for the number of contracts that should be shorted gives

\[ 1.2 \times \frac{20,000,000}{1080 \times 250} = 88.9 \]

Rounding to the nearest whole number, 89 contracts should be shorted. To reduce the beta to 0.6, half of this position, or a short position in 44 contracts, is required.

Problem 3.8.

A good rule of thumb is to choose a futures contract that has a delivery month as close as possible to, but later than, the month containing the expiration of the hedge. The contracts that should be used are therefore (a) July, (b) September, and (c) March.

Problem 3.9.

No. Consider, for example, the use of a forward contract to hedge a known cash inflow in a foreign currency. The forward contract locks in the forward exchange rate − which is in general different from the spot exchange rate.

Problem 3.10.

The basis is the amount by which the spot price exceeds the futures price. A short hedger is long the asset and short futures contracts. The value of his or her position therefore improves as the basis increases. Similarly it worsens as the basis decreases.

Problem 3.11.

The simple answer to this question is that the treasurer should (a) estimate the company's future cash flows in Japanese yen and U.S. dollars and (b) enter into forward and futures contracts to lock in the exchange rate for the U.S. dollar cash flows.

However, this is not the whole story. As the gold jewelry example in Table 3.1 shows, the company should examine whether the magnitudes of the foreign cash flows depend on the exchange rate. For example, will the company be able to raise the price of its product in U.S. dollars if the yen appreciates? If the company can do so, its foreign exchange exposure may be quite low. The key estimates required are those showing the overall effect on the company's profitability of changes in the exchange rate at various times in the future. Once these estimates have been produced the company can choose between using futures and options to hedge its risk.
Let $x_i$ be the change in futures price, and $y_i$ be the change in spot price.

\[ \Sigma x_i = 0.96 \quad \Sigma x_i^2 = 2.4474 \quad n = 10 \]
\[ \Sigma y_i = 1.3 \quad \Sigma y_i^2 = 2.3594 \]
\[ \Sigma x_i \cdot y_i = 2.352 \]

\[ \sigma_x = \sqrt{\frac{\Sigma x_i^2}{n-1} - \left(\frac{\Sigma x_i}{n}\right)^2} = 0.51156 \]

\[ \sigma_y = \sqrt{\frac{\Sigma y_i^2}{n-1} - \left(\frac{\Sigma y_i}{n}\right)^2} = 0.49333 \]

\[ \rho = \frac{n \Sigma x_i y_i - \Sigma x_i \Sigma y_i}{\sqrt{\left[n \Sigma x_i^2 - (\Sigma x_i)^2\right] \left[n \Sigma y_i^2 - (\Sigma y_i)^2\right]}} = 0.98057 \]

From Equation 3.1, the minimum variance hedge ratio, $h^*$, is therefore

\[ 0.98057 \times \frac{0.49333}{0.51156} = 0.9456 \]